Recreational demand for shellfish harvesting under environmental closures

Leif Anderson
Northwest Fisheries Science Center
NOAA Fisheries

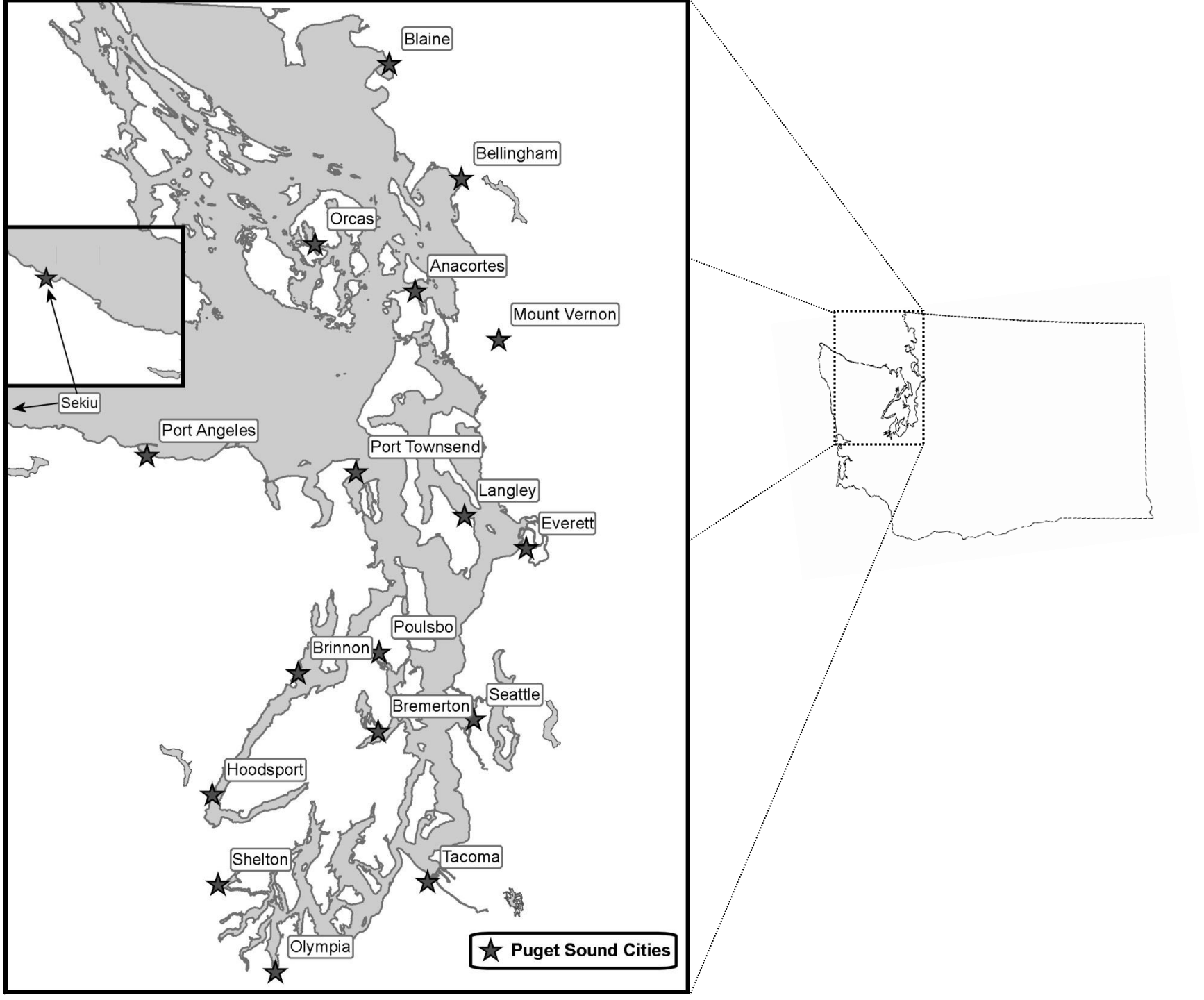
Anderson and Plummer, 2017. MRE. 32(1): 43-57.

Recreational clam and oyster harvesting is a popular activity in Puget Sound

133,688 estimated harvester days on *managed* beaches (WDFW, 2013)

Beaches are often subject to health-related environmental closures based on ongoing water quality assessments

Local resource management agencies (e.g., Puget Sound Partnership) have set a priority to reduce the risks of biotoxin and pollution closures on human health


Blaine
Bellingham
Orcas
Anacortes
Mount Vernon
Sekiu
Port Angeles
Port Townsend
Langley
Everett
Poulsbo
Brinnon
Seattle
Bremerton
Hoodsport
Shelton
Tacoma
Olympia
Puget Sound Cities

Harvest closures

Health-related closures set by Washington Dept. of Health

Health-related closures may be due to:

Biotoxins – diarrhetic shellfish toxins, paralytic shellfish toxins, domoic acid

Pollution (bacteria, viruses, or other)

Closures are posted online, in other media, and (often) at public beaches


DANGER
TOXIC SHELLFISH
DO NOT EAT clams, oysters, mussels, or scallops.
Shellfish in this area are unsafe to eat due to biotoxins.
위험! 치명적인 독성 조개류. 먹지 마십시오! .....
Nguy Hiểm! Nghêu sò bị nhiễm độc. Đừng ăn! .....
¡Peligro! Mariscos tóxicos. ¡No comer! .....
Опасно! Ядовитые моллюски. Не употреблять в пищу! .....
危險！有毒的貝類。切勿食用！.....
Always check the shellfish safety hotline:
1-800-562-5632 or
www.doh.wa.gov/shellfishsafety.htm
For more information, contact:
Health
360-236-3330

Shellfish Safety Information

Washington State Department of Health

Only the HEALTH STATUS of beaches are shown on these maps.

For SEASONS & LIMITS visit Washington State Department of Fish and Wildlife.

Marine Biotoxin Closure Zones

Closed for clams, geoduck, scallops, mussels, oysters, snails and other invertebrates.

Marine Biotoxin status updated, 6/18/2014 12:43:43 PM

Public Beaches

Closed

Area closed due to pollution.

Beach Information

Name: BIRCH BAY SP

Marine Biotoxin Closure
Closed for clams, geoduck, scallops, mussels, oysters, snails and other invertebrates.

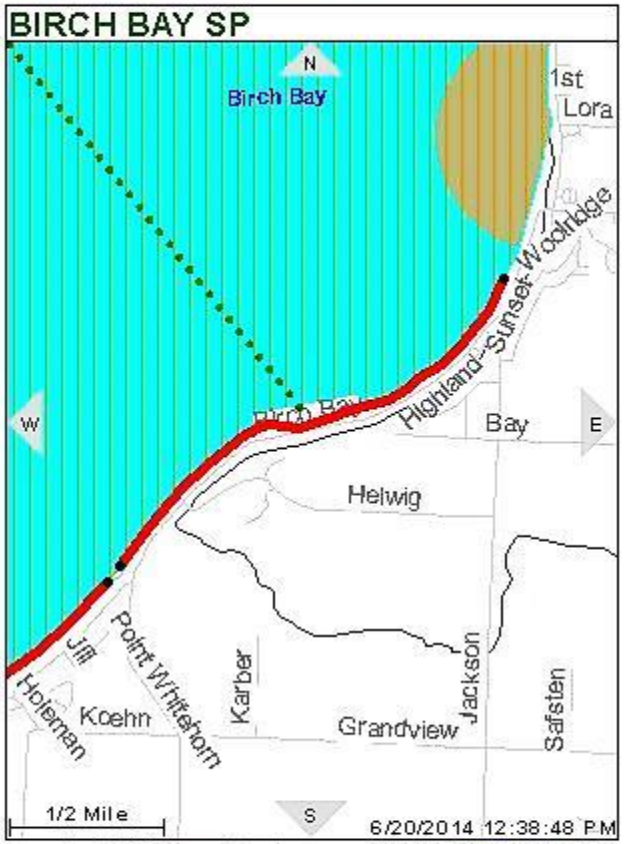
Owner: State Parks and Recreation

ADVISORY:
Water quality and shoreline conditions meet public health standards for recreational shellfish harvesting.

WDFW Regulations/Restrictions

DOE Shoreline Photo

Tide Predictions



Inside Whatcom County

Start Over

Emergency Closures Due to Marine Biotoxins and Vibrio - Text Version

County Beach List

Recreational Program

Fact Sheets

What are the effects of pollution and biotoxin closures on …

effort?

recreational use value?

Data for economic model

Puget Sound Recreational Shellfishing Survey

3 focus groups and 3 sets of one-on-one interviews : Seattle, Bellingham, Silverdale

Up to 6 contacts: phone, prenotice, 1st mailing, postcard, 2nd mailing, 3rd mailing

Fielded in 2013

Estimated response rate ~50%

Data include location of most often used beach, contingent behavior questions

Experimental design

4 contingent behavior questions on each of 25 survey versions

Attributes

- type of closure (biotoxin, pollution),
- length of closure (1, 2, 3, 12 months)
- species affected (all clams and oysters, butter clams only),
- additional distance to a nearby beach that is fully open (5, 10, 20, 30 miles)

Computerized search algorithm to max D-efficiency

"*How many trips would you take if the beach you most often use for harvesting clams and oysters was closed … ?*"

C3 Suppose that the Department of Health has closed an area for the entire season (January through December) that includes the Puget Sound beach you most often use for harvesting clams or oysters and there is a nearby beach that is not affected by this closure that is an additional 20 miles away.

Please review the following table and answer the questions below.

Information on the Closure and Your Alternatives	
Type of Closure	Biotoxin
Period of Closure	January through December
Species Closed to Harvest	Butter Clams Only
Additional Distance to a Nearby Beach that is Fully Open	20 miles

C3.1 **During this 12 month closure**, how many trips would you take to the beach you most often use, and to the nearby beach that is fully open?

Trips during the closure (January through December) to the <u>beach you most often use</u>:

Harvesting trips: ☐☐

Non-harvesting trips: ☐☐

Trips during the closure (January through December) to the <u>nearby beach that is fully open</u> (20 additional miles):

Harvesting trips: ☐☐

Economic model

Estimate demand for 3 trip types together in order to capture substitution between types of trips – incomplete demand system

3 trip types: harvest, alternate beach, non-harvest

Demand for trips = f (travel cost, demographics, closures)

$x_i = \alpha_i(z)exp(\sum_k \beta_{ik} P_k + \gamma_i y)$, negative binomial functional form

Standard restrictions for integrability ($\gamma_i = \gamma_k, \beta_{ik} = 0, \forall i \neq k, \beta_{ii} < 0, \alpha_i(z) > 0$)

$$x_i = \exp\left(\alpha_i + \varphi Priv + \sum_n \delta_{ni}\, Closed_n + \beta_i P_i + \gamma y\right)$$

Heterogeneous baseline demand for trip types ($\alpha_i \sim N$)

Variable			Coefficient Mean	Coefficient SD
Trip types (α_i)	Harvest		1.69819***	0.77735***
	Alternate		-0.56257***	1.38093***
	Nonharvest		-1.84539***	2.89039***
Price (β_i)	Harvest		-0.00783***	
	Alternate		-0.0081***	
	Nonharvest		-0.01053***	
Closed (δ_{ni})	Harvest	Biotoxin, All Species	-1.69773***	
		Biotoxin, Butter Only	-1.50156***	
		Pollution	-1.87221***	
	Alternate	Biotoxin, All Species	0.99405***	
		Biotoxin, Butter Only	1.25347***	
		Pollution	1.10273***	
	Nonharvest	Biotoxin, All Species	0.02859	
		Biotoxin, Butter Only	0.07575	
		Pollution	-0.0073	
Income (γ)			.11731D-05*	
Priv(φ)			-0.20512***	
NB Dispersion			2.15745***	

* p<0.10, ** p<0.05 *** p<0.01

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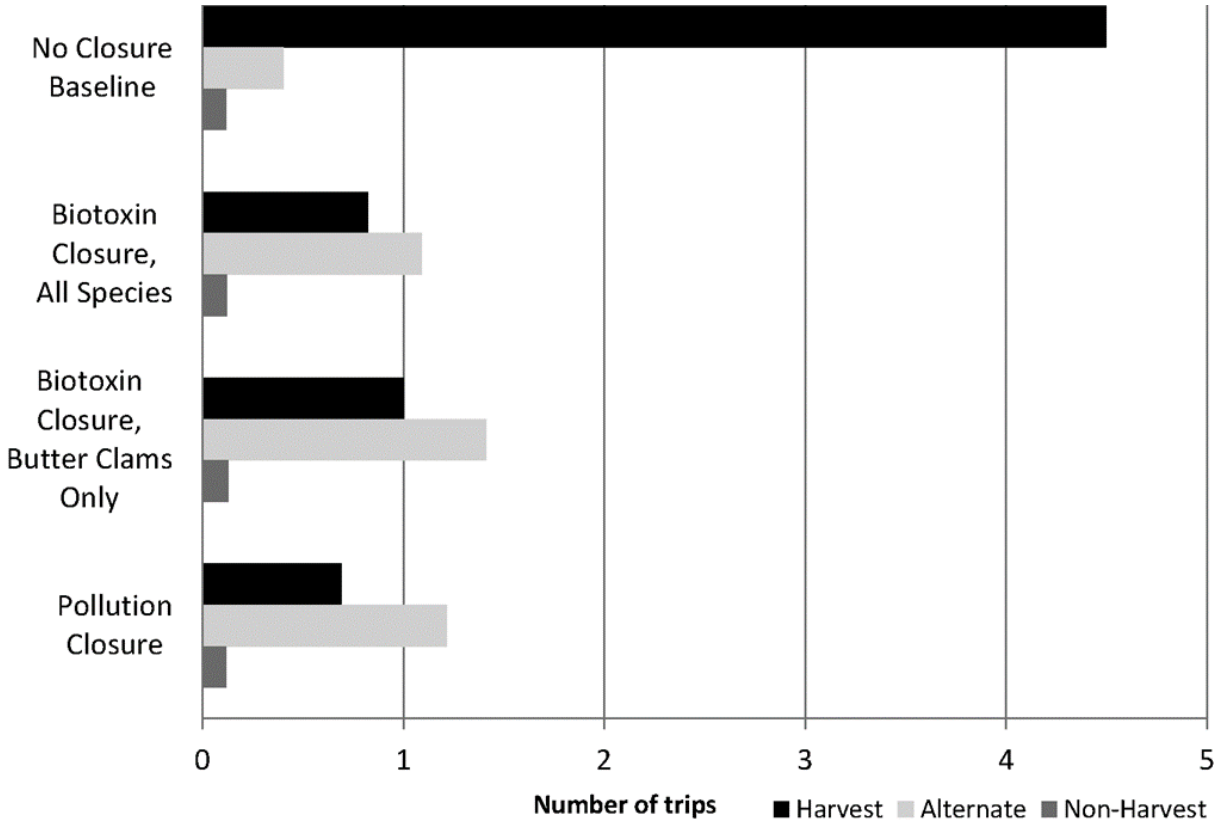
Annual trips



Willingness to pay

Willingness to pay for a …

harvest trip = $127.65

harvest trip to an alternate beach = $123.39

non-harvest trip = $94.93

Annual WTP

	Additional Miles to Open Beach			
Closure Type	5	10	20	30
No Closure	$ 641.14	$ 639.19	$ 635.49	$ 632.05
Biotoxin, All Species	$ 266.52	$ 261.25	$ 251.26	$ 241.96
Biotoxin, Butter Clams Only	$ 334.21	$ 327.38	$ 314.43	$ 302.37
Pollution	$ 266.46	$ 260.59	$ 249.45	$ 239.08

WTP to avoid closures consists of two components, a fixed effect and a portion that varies with distance to the nearest beach open for harvest

Most of the loss in value from a closure comes from having to use an alternate beach, rather than the additional travel cost

Future work

Incorporate 1-, 2-, and 3- month contingent behavior data in the economic model

Link the economic model with models of HAB incidence developed by Center colleagues

Existing work uncovers growth function for *Alexandrium* (temp, salinity) and increased future days favorable to growth (Moore et al. 2015. Harmful Algae 48: 1-11), but stops short of a predictive / causal link

Current work is attempting to model this link